starch and iodide test is so dependent upon other elements than the simple presence of ozone, that it is not thoroughly reliable. It is also open to the error of reacting to substances other than ozone. Still, admitting the statement that there is more nascent ozone at high elevations, the explanation of its action in the cure of phthisis is still to be sought. Some rather visionary theorists, as it seems to the writer, claim that it finds a direct admission to the diseased spots in the lungs, and, by its poorer oxidizing, it burns up *in loco* the morbid products.

We should rather attribute its influence to the fact, that, where ozone exists free, there is no decomposing matter to be oxidized. It seems to us to be indicative of the existence of pure air, rather than a direct agent in destroying the morbid products in the lungs.

4. *Immunity from phthisis.* — Another argument in favor of elevation in the cure of phthisis is, that at certain heights there exists an immunity from the disease. The disease is not endemic at such elevations.

This is in the nature of negative evidence; but it is certainly valuable as an element of prophylaxis, and we think that it can be applied as an argument in favor of cure. Ruehle (*op. cit.*) says, "A height of *at least* 1,800 or 2,000 feet seems to be requisite for this purpose. Phthisis is rare on the Hartz, Styrian (in Purzgau), and Swiss mountains." Jaccoud (Flint's Practice of medicine, p. 296) "states that the observations for fifteen consecutive years warrants him in asserting, that, in Alpine situations elevated 4,000 feet, tuberculosis is unknown; and especially is this true of villages at an elevation of 5,500 feet." Dr. Irwin reports for Fort Defiance (6,500 feet), north-western New Mexico, "During a service of some seven years in New Mexico and Arizona, I never saw or heard of a case of tuberculous disease amongst the native inhabitants of those territories." And Dr. Denison, in his work entitled 'Rocky Mountain health resorts,' writes, "After having quite thoroughly canvassed the subject among physicians of Colorado, I place the altitude of approximate immunity of this state at 6,000 feet."

Taking a mean of all these quotations, we may safely assert, that, broadly speaking, an altitude of from 5,000 to 6,000 feet affords an approximate immunity from this disease.

5. *An aseptic atmosphere.* — Lastly, we will speak of the influence of elevation in the cure of phthisis in producing an aseptic atmosphere. In these days of germ-theories and of Koch's experiments, we cannot but give emphasis to this element of antisepsis as an element of prophylaxis and cure of phthisis. Professor Tyndall's experiments show the abundance of germs floating in the air at sea-level, and an entire absence of such germs at the altitude of the 'Belle Alp' hotel (7,000 feet). Whether a lower elevation will furnish this aseptic atmosphere has not been proven experimentally; but it would seem to be reasonable to argue that an elevation corresponding to that of immunity from phthisis would furnish such an atmosphere.

Résumé. — There are other elements, such as humidity of the air, temperature, precipitation, etc., more or less dependent upon elevation, which we shall have occasion to speak of more at length. But, to make a *résumé* of our study to this point, we can say that a rise in elevation increases the heart-beat and the rapidity of the circulation, thereby hastening the absorption of the morbid products in phthisis, and increasing the metamorphosis of tissue, and hence the vital force; that it likewise produces greater depth of respirations, and a more healthy action of the diseased portions of the lungs; that it gives a purer air, and affords an approximate immunity from the disease; and, finally, that it affords an aseptic atmosphere, in which the Bacillus tuberculosis does not exist. The extent of elevation desirable for the production of this effect can be stated to be at least 5,000 feet.

Having arrived at these conclusions, it remains for us to apply them to our subject. By consulting table I., columns i. and ii., it will be seen, that, of all the resorts for the cure of phthisis in this country, the eastern slopes of the Rocky Mountains alone furnished the desirable elevation. The distance between Denver and Santa Fé is in the neighborhood of 375 miles in extent. Throughout this whole extent, pleasant locations for invalids are to be found at elevations varying from 5,000 to 6,000 feet.

(*To be continued.*)

HISTOLOGY OF INSECTS.

Inspired by Weissmann's well-known researches on the post-embryonic development of insects, Viallanes has studied the structure and changes of various tissues, principally in Musca vomitoria, but also in other insects during their metamorphoses. His results occupy nearly an entire volume,[1] and make an important addition to knowledge, the more welcome because the author deals chiefly with those tissues which have heretofore been least worked

[1] Vol. xiv. sér. vi. of Ann. sc. nat., zool.

upon. The long memoir embodies a large number of valuable data, the outcome of work which we believe to be thorough and careful. The collation of the literature is good, but not complete, some omissions being important. We are unable to give here more than the chief general conclusions.

The skin of the larvae studied consists of a single layer of large flattened cells, covered externally by the hard chitinous cuticula (containing lime in Stratiomys), which is smooth in Musca and Eristalis, but divided in Stratiomys into fields corresponding to the cells. Below the cells, and lying directly against them, is a thin anhistic membrane, which is comparable to the basal membrane in crustacea and adult insects.

The peripheral nervous system is of great interest. Between the integuments and the muscles of the larvae are found peripheral ganglia, which do not belong either to the ventral chain or to the stomatogastric system. No analogous observation has hitherto been made upon insects. The peripheral ganglia of the larva of Tipula are very remarkable from their regular disposition and their symmetry: there is a pair in each segment. Those of Musca are irregularly scattered between the skin and the muscles. Analogous ganglia are found in Eristalis, but are localized in the plexus, whence spring the nerves of the special sense-organs in the anterior region of the body. In the description of the peripheral nerves the author adds little to what was previously known.

The sensory nerves end in two ways, — either by a connection with sensory hairs of the epidermis, or with free terminations. In the former case the axis-cylinder dilates, at the base of the sensory hair, into a bi-polar ganglion cell. The sensory hair is a conical hollow process of the cuticula. It is secreted by a special, large, slightly modified epidermal cell, the protoplasm of which fills the cavity of the hair, and lines its base. The distal prolongation of the bi-polar cells unites with the protoplasm of the hair-cell, and does not run directly to the hair. This apparatus appears to subserve touch, smell, etc. The free terminations are found beneath the epidermis, as thread-like prolongations of a very rich dermal plexus, formed by very numerous multi-polar anastomosing nervous cells. (Besides the description of similar structures in other animals cited by Viallanes, *cf.* Canini and Gaule, SCIENCE, ii. **279.**)

Involuntary striated muscles. The larval heart is histologically comparable to a vertebrate capillary, being formed of flat cells soldered border to border. In the protoplasm of these cells, muscular fibres are formed, so that the cells are at once comparable to the endothelium and muscularis of the capillary. Within each single cell the fibrilla begins and ends with a thin disk or stria; therefore the space between the two disks is the unit of the fibril. In young larvae the heart is a simple tube without lateral openings. The striated muscles of the digestive tube are probably histologically identical with those of the heart, i.e., modified single cells; but Viallanes was unable to make out the cell-limits. In the walls of the stomach of Tipula is an intramuscular ganglionated nerve-plexus, which probably innervates the muscles; but the final terminations were not seen. This is regarded as confirmatory of Ranvier's law (*Leç. d'anat. génér.*, 1880, 463).

In regard to the voluntary muscles the following conclusions are drawn: the fibrillae of insects are homologous with those of vertebrates, although the latter are indivisible, while in insects certain fibrillae (of the wing-muscles) may be decomposed into fibriculae. In insects, as in vertebrates, the fibrillae are united into 'colonettes,' or little clusters, being closely cemented together by a homogeneous and continuous substance, into which neither protoplasm nor nuclei ever penetrate. In vertebrates a large number of colonettes are united within a common envelope, the sarcolemma, to form the fibre or primitive bundle. In insect larvae this disposition is maintained, but in the wing-muscles the sarcolemma is absent; the primitive bundle then consists of a few colonettes (Musca), or even of one colonette only (*cf.* Ciaccio, SCIENCE, i. **247**, whose paper is not cited). In the leg-muscles there is but a single colonette in each fibre, and the sarcolemma is scarcely developed. As regards the motor plates the following points are noted : 1°. In the larva of Stratiomys chamaeleon, each of the fibres, constructed on the vertebrate type, has several Doyère's cones, to the summit of each of which runs an axis-cylinder accompanied by a nucleated sheath. Before innervating the muscle, the nerves form a plexus; in the cone the axis-cylinder forms a terminal arborization by successive dichotomous branchings inside the sarcolemma; the fundamental substance contains neither granular matter nor nuclei. 2°. In Tipula there is a similar arrangement, but only one cone to each fibre; the terminal arborization is much more extended, and bears nuclei; and the basal substance of the cone is granular, and nucleated as in the terminal plates of Amniota. 3°. In the caudal muscles of Eristalis and the leg-muscles of Dytiscus, each fibre of which contains only a single colonette, the motor nerves form no arborization, but break up into their constituent fibrils as soon as they reach the sarcolemma.

The second part of the memoir deals with the very remarkable changes in the larval tissues at pupation. The corpuscles of the blood of the larva are embryonic cells analogous to the leucocytes of vertebrates, and are found in the same form in the pupae. The muscular fibres of the larva disappear at the commencement of pupal life, and in two ways : — First, by 'évolution régressive :' the nuclei of the muscle become spherical, and each surrounded by a coat of protoplasm, thus becoming a muscle-corpuscle, which proliferates, and gives rise to a great number of rose-colored granules, which multiply until the muscular substance entirely disappears, as if it supplied nutriment to the granules; these last finally separate, and spread themselves through the body cavity. Second, by degeneration: the nuclei keep becoming rarer until they all disappear, and meanwhile the contractile substance disappears as if

dissolved away on the outside. In consequence of these processes, the body cavity is charged with a quantity of matter resembling the vitelline elements of birds. The cells of the so-called fat-body produce, during the first days of pupal life, numerous granules, which enlarge, and are ultimately set free by the rupture of the cell-membrane. These granules arise independently of the nucleus, but closely resemble small cells. The cells of the tracheae and salivary glands do not disappear at the time of metamorphosis, as has been thought, but, on the contrary, they proliferate by endogenous cell-formation, the parent cell being first enlarged; the parent nucleus is finally discharged; the embryonic cells thus generated separate, and fall into the general body cavity. The *körnchenkugel* produced by pupal histolysis, and described by Weissmann, are of two kinds, and do not arise from the disintegrated matter, as supposed; but the smaller are derived from the muscle-corpuscles, the larger from cells of the fat-body. The epidermis of the larval head and thorax dries up and falls off. It is not immediately replaced by the definite cell-layer, but first by a thin cuticle, which Viallanes considers to be probably the thickened basement membrane of the larva.

Part third treats of the histogenesis of the tissues of the imago. The skin of the head and thorax is developed from Weissmann's imaginal disks. In the description of these, Viallanes follows Ganin in general, but he thinks that the mesoderm of the disks is formed at the expense of some of the embryonic cells in the body cavity. Other points are also brought forward, among which we note especially that the wing of the pupa contains at first numerous tracheae, which disappear before the end of the stage. In the abdomen, also, there are imaginal disks, four in each segment, and formed by local thickenings of the epidermis; all other parts of the epidermis or hypoderm degenerate, and are resorbed. The disks form two layers, the outer making the new epidermis, and the inner the mesoderm; the disks grow at their borders until they everywhere meet, and form a continuous tissue. The method of regeneration is the same as in the thorax, except that the disks are developed later: the difference assumed by Weissmann and Ganin is not real. The author compares the imaginal disks with the plates in Pilidium.

The internal muscular mass of the thorax is derived from a single anlage, composed of little cells embedded in a small amount of homogeneous basal substance. This anlage then separates into six cords, corresponding to the definite muscles; these grow by peripheral accretion; the muscular substance is then differentiated around the cells, which are disposed with great regularity in the midst of the colonettes, becoming, in fact, the muscle-corpuscles (the necessity of omitting a fuller account is much regretted. — *Rep.*). The muscles of the legs are derived from the mesoderm of the imaginal disks; the general process of their histogenesis, despite many interesting differences, is the same as that of the wing-muscles. The author makes an excellent comparison between the unicellular muscles (heart, stomach) and the pleuricellular (wings, legs), or, as we might name them, the mesenchymal and myothelial muscles.

Nearly a fifth of the entire memoir is devoted to the development of the eye. The brief *résumé* (p. 302–305) is the most succinct and perfect account of the structure of the compound eye with which we are acquainted. In the first section the structure of the developed eye of the pupa, before it becomes pigmented, is described. The following is the author's table of the parts of the visual apparatus: —

Œil composé . . .	Cornée à facettes. Couche des cellules cristalliniennes. Couche des rétinules ou rétine. Limitante postérieure de l'œil composé.
Couche des fibres post-rétiniennes.	
Lame ganglionnaire	Limitante antérieure de la lame ganglionnaire. Couche des cellules ganglionnaires. Couche des fibres en palissade. Limitante moyenne de la lame ganglionnaire. Couche des fibres nucleées. Limitante postérieure de la lame ganglionnaire.
Couche des fibres préganglionnaires.	
Ganglion optique .	Névrilemme. Couche des cellules en chapelets. Croissant du noyau central. Éventail du noyau central. Écorce grise du ganglion optique.

Concerning the development of the eye, we give the following conclusions. In the larva, before metamorphosis, the eye is represented by three parts, — the imaginal disk of the eye proper, the neural stem, and the optic ganglion. The disk of the eye comprises the same three layers as the other imaginal disks. Before the metamorphosis of the larva, the superficial cells of the exodermic layer become enlarged and elongated, and acquire a strong affinity for coloring-matters; they are the optogenic cells. This change begins in the centre, and spreads towards the periphery of the disk. The mesoderm of the disk of the eye, unlike the other two layers, is different from the corresponding portion of other disks, since it is composed of fine nerve-fibrillae mingled with nuclei; by teasing, it can be shown that each fibril is connected with the inner end of an exoderm cell. The nervous stem unites the disk of the eye with the optic ganglion, and is composed of the nerve-fibrils mingled with nuclei. The optic ganglion is constituted by the outer portion of the brain; its nucleus consists of white, its cortex of gray, matter; in the lateral portion of the cortex, is the complex anlage of the *lame ganglionnaire*, in which all the principal constituent parts of the definite *lame ganglionnaire* can be recognized. At the moment of metamorphosis the following phenomena occur: the provisory layer of the disk of the eye disappears, the exoderm enlarges, its borders unite with the neighboring disks, its cuticle becomes the faceted cornea, and its optogenic cells each form, by the known process, an elementary eye. The anlage of the *lame ganglionnaire* emigrates from the optic ganglion, then enlarges, and spreads out so as to intervene between the ganglion and the eye. The

details of the differentiation of the *lame* are carefully described.

I cannot conclude this notice without referring to the admirable manner in which this valuable memoir is written, and the great clearness with which the facts and conclusions are presented.

CHARLES S. MINOT.

EXPERIMENTS TO DETERMINE THE GERMICIDE VALUE OF CERTAIN THERAPEUTIC AGENTS.

IN the *American journal of medical sciences* for April, Dr. Sternberg gives an account of his study of this important question. The objects of the author were, —

To ascertain the exact value, as germicides, of some of the agents most frequently employed in medical and surgical practice, with a view to the destruction of pathogenic micro-organisms, hypothetical or demonstrated.

To compare this value, established by laboratory experiments, with the results of clinical experience, for the purpose of ascertaining what support, if any, the germ-theory of disease receives from modern therapeutics.

Assuming that the active agent in infective material is a living micro-organism, or 'germ,' disinfection will be accomplished by those chemical agents only, which have the power of destroying the vitality of this organism. We require to know: —

a. What is the absolute germicide power of various disinfecting agents, in order to select the best with a view to economy and efficiency;

b. Are all disease-germs destroyed by these agents in the same proportion? and, if not,

c. What agents are the most available for special kinds of infective material?

In therapeutics we should know, in addition to this: —

d. What is the minimum quantity of each of these agents which will restrict the multiplication of each specific disease-germ in a suitable culture-medium? — this with reference to medication, with a view to accomplishing a like result within the body of an infected individual.

Evidently, any thing like a complete answer to these questions is quite impossible in the present state of knowledge, and we must content ourselves with such partial or approximate answers as can be obtained by laboratory experiments upon the comparatively small number of pathogenic organisms which abound in organic liquids undergoing putrefaction.

The experiments were conducted by using small sealed flasks containing bouillon free from micro-organisms. The smallest quantity of a fluid containing such organisms introduced into one of the flasks would cause it to 'break down' within twenty-four hours, it being exposed during this time to a temperature of 100° F.

To test the germicide power of a chemical reagent, living bacteria are subjected to its action in a known proportion for a given time, and are subsequently used to inoculate sterilized bouillon in one of the flasks. Failure to multiply in this fluid, when exposed for twenty-four hours or more to a temperature of 100° F., is evidence that reproductive power — vitality — has been destroyed by the reagent used. On the other hand, failure to disinfect, i.e., to destroy the vitality of the bacterial organisms used as a test, is shown by the 'breaking-down' of the culture-fluid.

Standard solutions of the reagents to be tested are prepared with distillled water. The germs are exposed, in small glass tubes, to the action of these agents for two hours. The tubes are sterilized in the flame of an alcohol-lamp immediately before each experiment; they are open, and covered by a bell-glass during the time of exposure.

At the end of the time of exposure, a small quantity of the fluid from one of the tubes is introduced into a flask containing sterilized bouillon, and this is exposed to a temperature of 100° F. for twenty-four hours.

The micro-organisms which have been used in the experiments herein reported, to test the germicide power of the reagents named, were obtained from the following sources: —

a. A micrococcus from gonorrhoeal pus.

b. A micrococcus from pus obtained from an acute abscess (whitlow) at the moment that it was opened by a deep incision. This micrococcus is morphologically identical with the preceding.

c. A pathogenic micrococcus, having distinct morphological characters obtained from the blood of a septicaemic rabbit.

d. Bacterium termo, and other bacterial organisms (micrococci and bacilli) from 'broken-down' beef-tea which had been freely exposed to the air.

In the following table, which is arranged according to the germicide value of the agents named, all experiments are given in which the micrococcus from pus was used as a test.

Mercuric bichloride (0.005 per cent), efficient in the proportion of one part in	20,000
Potassium permanganate (0.12 per cent), efficient in the proportion of one part in	833
Iodine (0.2 per cent), efficient in the proportion of one part in	500
Creosote (0.5 per cent), efficient in the proportion of one part in	200
Sulphuric acid (0.5 per cent), efficient in the proportion of one part in	200
Carbolic acid (1 per cent), efficient in the proportion of one part in	100
Hydrochloric acid (1 per cent), efficient in the proportion of one part in	100
Zinc chloride (4 per cent), efficient in the proportion of one part in	50
Tinc. ferri chloridi (4 per cent), efficient in the proportion of one part in	25
Salicylic acid dissolved by sodium borate (4 per cent), efficient in the proportion of one part in	25
Caustic potash (10 per cent), efficient in the proportion of one part in	10
Citric acid (12 per cent), efficient in the proportion of one part in	8
Chloral hydrate (20 per cent), efficient in the proportion of one part in	5

The following-named reagents, as far as the experi-